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Bibliometric Analysis of Research Related to Digital Literacy Using the Scopus Database from 2017-2023

Abstract: This research aimed to carry out a bibliometric analysis of research related to digital literacy using the Scopus-indexed articles database which was published from 2017-2023. To collect data, the author used a document Analysis or documentation instrument, and a sample of collected 665 articles from the Scopus publications was obtained through the application of the saturated sampling technique. The data were analyzed through the R Program Biblioshiny package. The first finding is that a steady rate of publications in the field of digital literacy was observed from 2017 (68 articles) up to 2022 (131 articles). The second finding is that keywords like “e-learning”, “digital literacies”, and “students” have higher bibliographical coupling indexes of 29, 26, and 23 respectively. For the third finding, the concepts of “e-learning” and “information literacy” are very important terms within their network. Besides, authors whose works had had much attention have included “e-learning”, “digital storage,” “computer science”, “digital environment”, “education”, “curricula”, and “students” in their words. Based on these findings, the main recommendation is for researchers to make further investigations in order to discover why works including the keywords like “e-learning”, “digital literacies”, and “students” are mostly cited.

Keywords: digital literacy, bibliometric, e-learning, bibliographical coupling, information literacy, students.

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Introduction

The ultimate purpose of research is to discover, develop a tool, and bring in new information or knowledge that eases or develops science, technology, and human coherence (Fatihudin and Holisin, 2011: 4). This explains the common question researchers put to themselves: “how was this topic addressed by others?” There is no common path to bring such novelty though. What is undeniable is how data gathering and related analysis is crucial to the research findings (Medeiros, et al., 2018).

Digital literacy is a topic that was addressed by researchers in different areas. One area of interest for researchers is the impact of digital literacy on education. With the increasing use of technology in the

classroom, digital literacy has become an essential skill for students. A study by Van Deursen and Van Dijk (2014) found that students who were more digitally literate had higher academic performance and were more engaged in their studies. This suggests that digital literacy can be an important factor in academic success. Some researchers tackled the aspect of how digital literacy is going to affect the future of teachers' training (Begimbetova et al., 2022).

Digital literacy is becoming increasingly important in today's society, as technology continues to play a pivotal role in our daily lives (Arlinwibowo et al., 2020; Kassymova, 2018; Sheriyev et al., 2016). According to a study by Hargittai and Hsieh (2013), digital literacy is the ability to access, evaluate, and use digital information effectively. Digital literacy encompasses a wide range of skills, including the ability to navigate digital technologies, critically evaluate digital information, and communicate effectively using digital tools.

One important aspect of digital literacy is the ability to navigate digital technologies. As noted by Hargittai and Hsieh (ibid), individuals with higher levels of digital literacy are better able to navigate digital technologies and use them to their advantage. This includes using search engines to find information, using social media to connect with others, and using productivity tools to improve work efficiency.

Another key aspect of digital literacy is the ability to critically evaluate digital information. As noted by Lankshear and Knobel (2011), individuals with higher levels of digital literacy are better equipped to critically evaluate the quality and reliability of digital information. This includes assessing the credibility of sources, identifying biases and inaccuracies, and distinguishing between fact and opinion.

On top of that, digital literacy also includes the ability to communicate effectively using digital tools. This includes using email, instant messaging, video conferencing, and other digital communication tools to connect with others. As noted by Warschauer (2023), individuals with higher levels of digital literacy are better able to communicate effectively using digital tools and can leverage these tools to expand their social and professional networks.

Another area of interest for researchers is the relationship between digital literacy and social inequality. Some researchers argue that the digital divide, or the gap between those who have access to technology and those who do not, can lead to social inequality. A study by Warschauer and Matuchniak (2010) found that students from lower-income families had less access to technology and were less digitally literate than their wealthier peers. This suggests that digital literacy can play a role in perpetuating social inequality and that efforts should be made to bridge the digital divide.

Digital literacy becomes very interesting as some are doing well by accommodating it while others do not. This creates a digital divide addressed by Pluye, El Sherif, Bartlett, Granikov, Grad, Doray, Lagarde, Loignon, and Bouthillier (2018). This divide is likely to continue given the other factors affecting the mastery of digital literacy. The divide was mostly even during the lockdowns caused by Covid-19, (Azizah et al., 2021); some teachers struggled while others coped well with teaching online (Ndayizeye, 2021).

While researching the effect of digital literacy skills on virtual lectures during covid-19, Sukarno and Widdah (2020) found that digital literacy skills highly correlated with the learning of the “Methods and Strategy on Physic Learning” class. Digital literacy is not going anywhere then, rather researchers project that it will be heightening educational transformation. Recent work in Mexico defended how higher education is going to go through a stream of transformation thanks to a wave of digital literacy mastery among lecturers (Okoye et al., 2022).

Internet use, together with related skills, may have negative effects as distractors of learning. But when parents give support to their children, the student's digital literacy skills are well exploited (Gruchel et al., 2022).

Overall, digital literacy is a complex and multifaceted concept that encompasses a wide range of skills and abilities. As noted by various scholars aforementioned, individuals with higher levels of digital literacy are better equipped to navigate digital technologies, critically evaluate digital information, and communicate effectively using digital tools. As technology continues to play an increasingly important role in our daily lives, digital literacy will become an increasingly important skill set for individuals to possess. The aim of the research

The research questions:

1. What is the current state of research related to digital literacy, based on bibliometric analysis of the Scopus database from 2017-2023?

2. Which fields have shown the greatest interest in research related to digital literacy over the past five years, based on bibliometric analysis of the Scopus database?
3. How can bibliometric analysis, in co-occurrence networks and factorial analysis, provide insights into research related to digital literacy?

Research objectives:

1. To conduct a bibliometric analysis of the Scopus database from 2017-2023 in order to determine the current state of research related to digital literacy;
 2. To identify the fields that have shown the greatest interest in research related to digital literacy over the past five years through bibliometric analysis of the Scopus database;
- To investigate how bibliometric analysis techniques, such as co-occurrence networks and factorial analysis, can provide insights into research related to digital literacy.

Research Methods

Research Design: This is an ex-post facto research that uses secondary data from the Scopus-indexed journal article in the area of digital literacy.

Data Source: Scopus-indexed journal articles related to digital literacy.

Data collection instruments: Document Analysis or documentation instrument was used to collect 665 articles from the Scopus publications.

Sampling methods and techniques: In this research, the investigator used the probability sampling method. As far as the sampling technique is concerned, the researcher used the saturated sampling technique (Sugiyono, 2015).

Data Analysis Techniques: The researcher used the R program, especially the “bibliometric” package that she ran in the biblioshiny interface; henceforth the choice of this article’s title as a bibliometric analysis.

Research Results

To display the findings in the research, the researcher dimmed it right to show them based on some of the categories or biblioshiny indices. These include the general or main information, free-field plot, and co-occurrence network.

Main information

Based on Figure 1, this study covers the period from 2017 to 2023 and involved 1527 authors conducting research on digital literacy using 2078-related keywords. The research analyzed 665 articles from various sources, including books and journals, selected based on their discussion of digital literacy fields or aspects. Among the 665 articles analyzed, 168 were single-authored works. The study referenced 29976 sources, with an average document age of 3.01 years. The average number of co-authors per article was 2.56, suggesting significant collaboration among researchers. The research achieved an average of 9.633 citations per article, indicating that it was highly regarded by other scholars in the field. The visualization of the information aforementioned can be seen in Figure 1 below:



Figure 1. Main Information

The annual scientific production in areas related to digital literacy can be seen in the Figure 2 below:

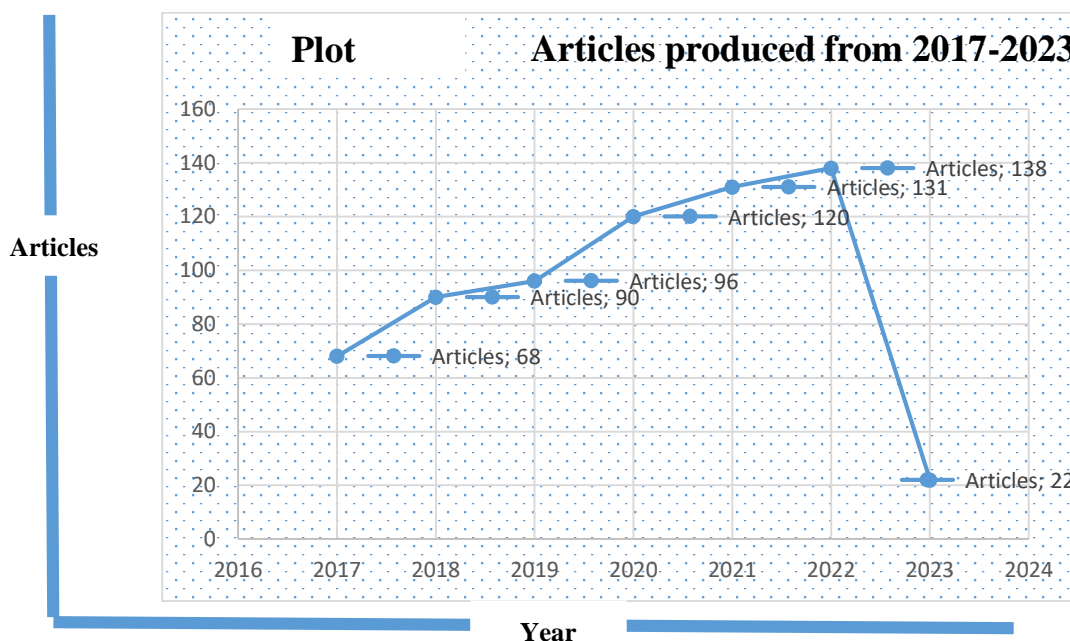


Figure 2. Annual Scientific Production around the “digital literacy” Keyword

Figure 2 describes the number of articles published each year from 2017 to 2023. The number of articles published has increased steadily each year, from 68 articles in 2017 to 138 articles in 2022. The peak is in 2022 whereby the amount climaxed to 138 articles. Even in the year 2023, there are 22 articles published so far.

The increase in the number of articles published over time suggests that the field or discipline related to digital literacy is growing. It may also indicate an increasing interest in the topic among researchers and practitioners.

It is important to note that the number of articles published does not necessarily reflect the quality of the research or the impact of the work. However, it can provide an indication of the level of activity, interest, and collaboration in this field of digital literacy.

Three-field Plot (Sankey diagram): The three-field Plot (Sankey diagram) saves a visualization tool. It shows the flow of research in different countries or regions. As a scatter plot, there are three variables in its display interface: the total number of publications; the citation impact, and the international collaboration rate. In this research, the author tracked the use of the keywords like digital/media literacies, digital literacies, information literacy, new literacies (digital/media) literacies, and media literacy.

Table 1. Keywords and Number of collaborations involved

No	Keyword	Number of international collaboration rate
1	digital/media literacies	13.0
2	digital literacies	9.0
3	information literacy	8.0
4	new literacies (digital/media) literacies	8.0
5	media literacy	1.0

On the other hand, as you can see, Table 1 shows that the keyword "digital/media literacies" has the highest international collaboration rate of 13.0. This indicates that research in this area is often conducted collaboratively across different countries. The keyword "digital literacies" has an international collaboration rate of 9.0, which is also quite high.

Table 2. Centrality measures

Node	Cluster	Betweenness	Closeness	PageRank
digital literacies	1	194.66	0.01	0.07
education	1	56.47	0.01	0.04
teaching	1	23.08	0.01	0.04
digital devices	1	7.54	0.01	0.02
computer science	1	7.91	0.01	0.02
information literacy	2	195.39	0.01	0.07
e-learning	2	444.26	0.02	0.12
media in education	2	3.16	0.01	0.02
education computing	2	0.41	0.01	0.02
digital libraries	3	2.83	0.01	0.02
information management	3	1.87	0.01	0.01
libraries	3	7.94	0.01	0.02
public library	3	1.75	0.01	0.02

Page Rank: a measure of the importance of a node based on the idea that important nodes are linked to other important nodes.

From the table, we can see that nodes in the same cluster tend to have similar centrality measures. Note that centrality refers to the importance of a node (keyword or concept) within the network, Gómez (2019). So, a comment that can be made on the clusters in our bibliometric study is that:

Cluster 1 (digital literacies, education, teaching, digital devices, and computer science) has relatively low centrality scores compared to the other clusters.

Cluster 2 has two nodes with very high centrality scores: e-learning and information literacy. These nodes are important in connecting other nodes in the network and are also important nodes that are linked to other important nodes.

Cluster 3 contains digital libraries, information management, libraries, and public library, which all have low centrality scores. These nodes are less important in connecting other nodes in the network, and they are not linked to other important nodes as frequently.

Bibliographical Coupling: The thematic map below has eight clusters. Considering the author’s keywords, niche topics within the realm of digital literacy encompass human-computer interaction, decision-making, fake news, and semi-structured interviews. Currently, there are no noticeable trends indicating emerging or declining themes in this area. However, the fundamental themes can be classified into behavioral research, digital devices, digital technologies, education, computer science, and surveys. Lastly, the motor theme cluster comprises e-learning, digital literacies, and students.

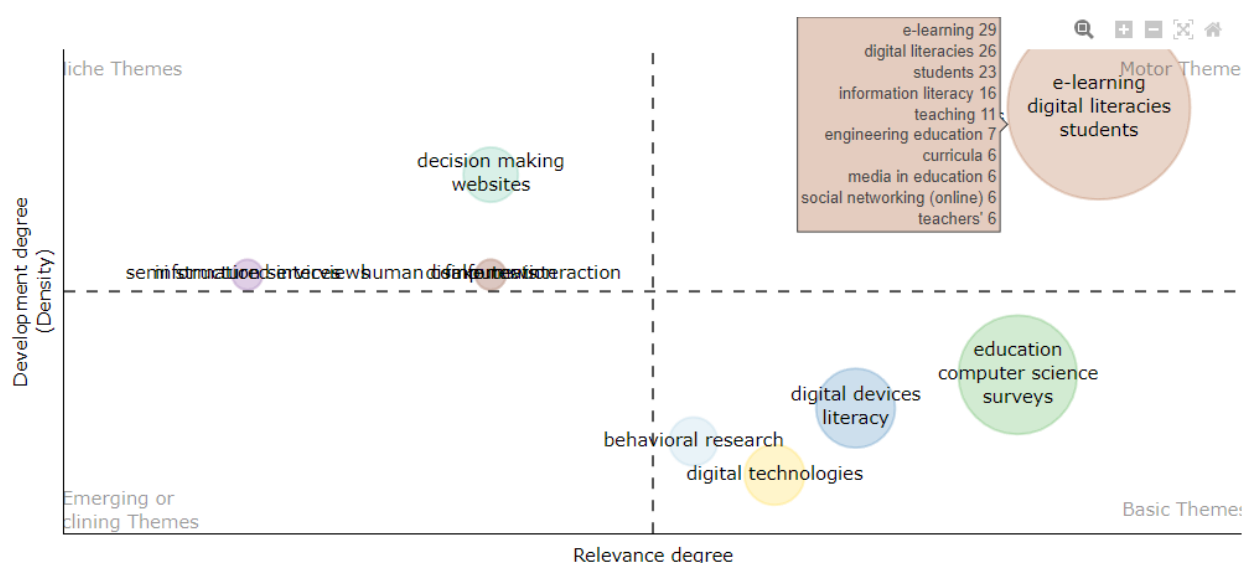


Figure 5. Thematic Map

Something particular about that motor theme cluster is the fact that the bibliographical coupling index amounted to 29, 26, and 23 respectively for e-learning, digital literacies, and student keywords.

Data involving the digital literacy keyword have a large number of variables such as author names, publication titles, keywords, and citation counts. To reduce the complexity of interpreting results, a factorial analysis is worth doing. Note that factorial analysis was used in our bibliometric analysis as a statistical technique to identify patterns and relationships among multiple variables in our digital literacy Scopus-indexed articles dataset.

The following map resulted from the factorial analysis of digital literacy-related keywords: When related parameters were applied to include keywords related to the ‘digital literacy’ field, there was an automatic clustering and the maximum number of terms was 55. Then the researcher applied factorial analysis as a statistical method to identify a smaller number of underlying variables (Figure 6).

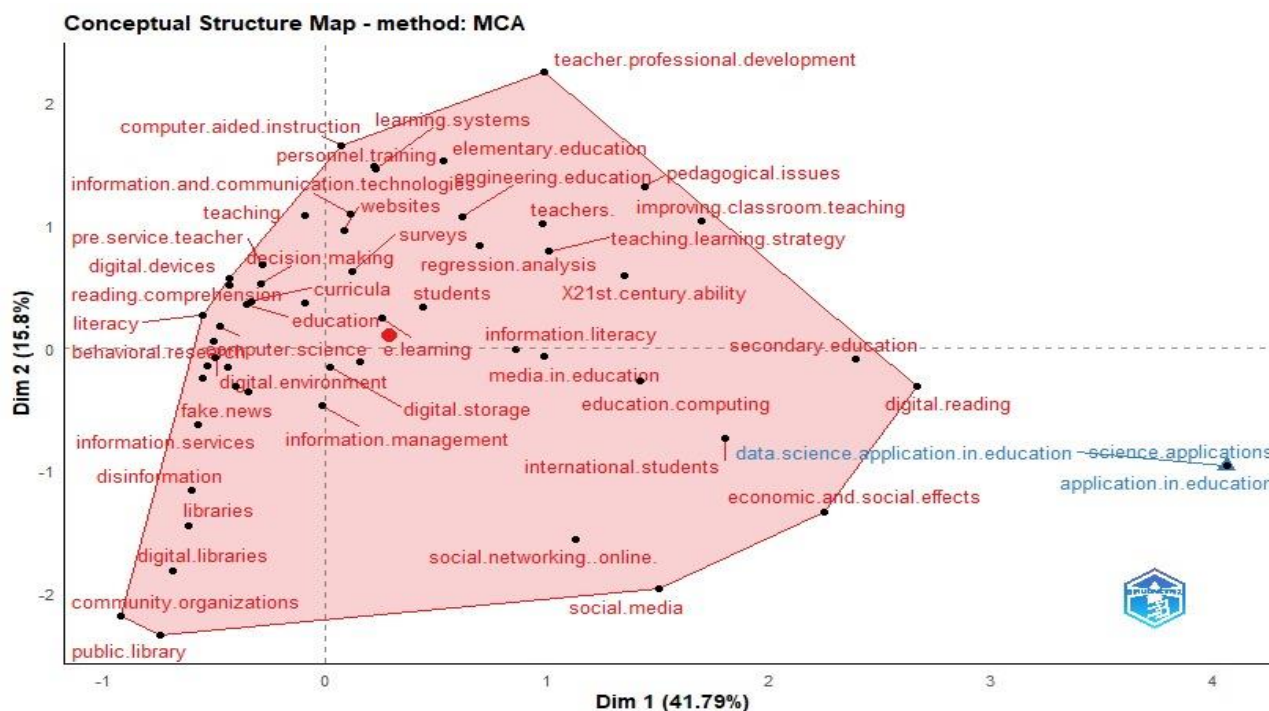


Figure 6. Factorial Analysis

The conceptual structure map that results from such a factorial analysis has two dimensions (Dim.1 and Dim.2), each with positive and lower values:

In dimension 1, keywords located in the positive area (positive values) imply that there is a lot of scholarly output related to them. Keywords that can be listed here are e-learning, information literacy, X21st century ability, teacher professional development, teaching, students, pedagogical issues, and teaching-learning strategies.

Conversely, the lower positive area in dimension 1 signifies that there has been less productivity about keywords in there. Researchers are prolific about these particular keywords. In this study, one can list: digital storage, information management, media in education, international students, digital reading, social networking online, social media, economic, social effects, and data science application in education

In dimension 2, the keywords in the positive areas show the quality (depth) or high impact the scholarly activities have been. Such positive values can also imply a high number of citations these keywords get. High-quality scholarly output has been around keywords like computer science, literacy, education, curricula, digital devices, teaching, and computer-aided instruction.

The lower values in dimension 2 refer to low-quality or low-impact scholarly output gets. Keywords in this area are digital environment, fake news, disinformation, libraries, digital libraries, community organizations, and public libraries. The more a keyword/value approaches the center (for example e-learning our study), the closer the attention it received in recent years (Kassymova et al., 2021).

Discussion of Research Results

Under this section, the researcher positions her findings in the middle of other academics' bibliometric analysis research findings in the field of bibliometric analysis as applied to digital literacy. All is done by keeping track of the research questions in the study.

The first research question reads as:

1. What is the current state of research related to digital literacy, based on bibliometric analysis of the Scopus database from 2017-2023?

The finding is that the number of articles published has increased steadily each year, from 68 articles in 2017 to 138 articles in 2022. The peak is in 2022 whereby the amount climaxed to 138 articles. This simply indicated how increasing research about digital literacy is becoming. This finding resonates with Hicks et al. (2022) findings. In their research, they showed how to leverage information literacy and appropriate it in other disciplinary landscapes. Their findings were that professional fields were leveraging information literacy, including in areas where librarians are.

The results suggest a steady rate of publication in this field, with most of the research published in education and library fields, (Baber et al., 2022).

The researchers applied a systematic literature review method to the dataset. The preliminary findings demonstrated that there is a growing prevalence of digital literacy articles starting from the year 2013-2023, (Tinmaz and Fanea-Ivanovici, 2022).

For the aspect of digital literacy with the greatest interest, the related research finding is:

2. Which fields have shown the greatest interest in research related to digital literacy over the past five years, based on bibliometric analysis of the Scopus database?

To gather insights leading to a related finding, two indexes can illuminate our views:

- the number of articles published around the digital literacy keyword;
- the bibliographical coupling, that is, when two or more authors reference the same work.

The fact that the number of the sampled Scopus-indexed articles related to digital literacy aspects increased steadily, that is, 68 in 2017 and 138 in 2022 means that this discipline is interesting to researchers. This is just a sample in which the researcher applied fixed filters, which means that there are many other articles related to literacy that were not analyzed due to the filters set. Besides, even though the number of articles published does not necessarily reflect the quality of the research or the impact of the work, such a number indicates an increasing interest in digital literacy-related fields or how such literacy is influencing other fields.

What is more, the bibliographical coupling indicates an increase in interest as well. Plot #5 is indicative. It is obvious that if two or more research works both cite one or more documents in common, there is a bibliographical coupling; they have the same interest. The more works are coupled bibliographically, the more their authors have an interest in the topics covered by the documents they cite.

The thematic map analysis indicated these bibliographical coupling and the keywords of interest. Note the motor theme cluster includes: e-learning, digital literacies, and students.

Something particular about that motor theme cluster is the fact that the bibliographical coupling index amounted to 29, 26, and 23 respectively for e-learning, digital literacies, and student keywords.

This finding echoes the one made in Parra, Nuñez, and Vergara (2023). In their work, they found out that terms like "Digital media literacies" and "teachers" were the main topic in the research field and the theme focused on teacher-oriented or teacher-focused digital media literacy.

In terms of co-occurrence networks, that is, identification of relationships between keywords/terms/ or concepts within a body of digital literacy literature from 2017-2023, the related research question was formulated as follows:

3. How can bibliometric analysis, in co-occurrence networks and factorial analysis, provide insights into research related to digital literacy?

Co-occurrence in the context of this study means the frequency with which two or more keywords appear together in a set of articles related to our main keyword "digital literacy." Scrutiny of Cluster 2

reveals insights into the finding related to this research question: "e-learning" and "information literacy" nodes have the highest centrality scores. This means the two aforementioned nodes are very important keywords or concepts within their network, (see Figure 4). This finding is the opposite of what Aydin & Yildirim, (2022) found out in their research. For these two experts, the co-occurrence analysis indicated rather that concepts like "teachers' digital competence", "higher education studies", "teacher training programs", and "ICT in education" were nodes with the highest centrality. This difference may be due to the filter these two studies used.

Surprisingly, the newest nodes found in our study like digital libraries were also a finding in Hicks et al. (2022). These authors observed that professional areas like libraries are leveraging information literacy.

Equally similar results are traceable in Samadbeik et al. (2022). They themselves sampled 241 articles on the digital divide and COVID-19 from the Scopus database between 2020 and 2021. The keywords co-occurrence analysis showed that four main clusters included keywords like: 'telemedicine', 'Internet access and Internet use', 'e-learning', and 'epidemiology'.

As far as factorial analysis is concerned below is the finding. Note that factorial analysis is a bibliometric analysis that uses statistical techniques to identify patterns and relationships among multiple variables in our digital literacy.

Results on factorial analysis reveal that authors whose works had much attention have included the following keywords in their articles: e-learning, digital storage, computer science, digital environment, education, curricula, and students (Begimbetova et al., 2023).

Conclusions and Research Recommendations

On the research question about the state of research related to digital literacy, the results suggest a steady rate of publication in this field, with most of the research published in education and library fields.

Research question 2 is related to the greatest interest in research in the digital literacy research field. The finding was insinuated through the bibliographical coupling indexes like 29, 26, and 23 respectively for e-learning, digital literacies, and students; these suggest a high research interest in digital literacy-related fields.

As far as research question 3 is concerned, keywords like "e-learning" and "information literacy" are very important terms or concepts within their network

What is more, the factorial analysis reveals that authors whose works had much attention have included the following keywords in their articles: e-learning, digital storage, computer science, digital environment, education, curricula, and students.

There is one main recommendation that can be made: further studies should illuminate the reason why the works that included keywords like "e-learning", "digital literacies", and "students" are mostly cited.

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